REMARKS/ARGUMENTS

Applicant would like to thank the Examiner for the thorough review of the present application. Based upon the amendments and the following remarks, Applicants respectfully request reconsideration of the present application and allowance of the pending claims.

The Present Invention

The present invention encompasses an automatic exposure control process for multi-dimensional imaging devices capable of operating in a multitasking environment. The process is implemented in two distinct modules. The image control or first modules controls the imager by updating the imager with *adjusted exposure and gain settings*. The histogram processing or second module does the computations on the image to determine what exposure and gain settings should be targeted (i.e., *calculates a new gain and exposure*). The imager control module receives end of frame signals from an imager and the histogram processing module calculates a target contrast from gain and exposure data communicated from the imager (i.e. feedback), and image data in memory. The histogram processing module then communicates the target contrast to the imager control module. The imager control module uses the received target contrast to derive exposure and gain settings that are written to the imager.

The Office Action

The Examiner has rejected Claims 1-48. Claims 1-13 and 18-47 stand rejected under 35 U.S.C. § 102 (b) as being anticipated by United States Patent No. 5,815,200, issued to Ju et al. Claim 48 stands rejected under 35 U.S.C. § 102 (b) as being anticipated by United States Patent No. 5,258,484, issued to Kondo et al. Claims 14-17 stand rejected under 35 U.S.C. § 103 (a) as being unpatentable over United States Patent No. 5,815,200, issued to Ju et al. in view of Untied States Patent No. 5,548,108, issued to Moldskred et al.

35 U.S.C. § 102 (b) Rejections

Claims 1-12 and 18-47 stand rejected under 35 U.S.C. 102 (b) as being anticipated by United States Patent No. 5,815,200 issued to Ju et al. (the '200 Ju patent).

According to the Office Action, the '200 Ju patent teaches all of elements of Claim 1. Specifically, according to the Office Action, the '200 Ju patent teaches:

An imaging device (**10**) for capturing optical image data (**Figure 1, Column 1, lines 15-20**), the device comprising:

an imager (**60**) for generating an image signal (**Figure 1, Column 5, lines 65-66**);

a memory component (implied by **204**) that receives the image signal from the imager and stores the image signal as image data (**Column 6, lines 21-22 and Column 7, lines 20-24**); and

a processor (51) that executes an exposure control routine by implementing a first module (implied by **202 & 216**) that controls the exposure and gain setting in the imager (**Column 6, lines 10-18 and lines 36-43**) and a second module (implied by **206-212** and **220-226**) that implements computations in response to exposure data transmitted from the first module to determine a targeted exposure and gain setting. (Figures 2 and 3, Column 6, lines 18-35 and lines 43-61).

The '200 Ju Patent Does Not Teach a First Module that Controls the Gain and Exposure and a Second Module that Calculates a New Gain and a New Exposure

The teachings of the '200 Ju patent are distinguishable from the claimed invention in that the Ju patent does not teach a first module that controls the exposure and gain setting in the imager and a second module that determines a targeted exposure and gain setting.

The '200 Ju patent teaches at Column 6, lines 14-35 a gain control circuit (i.e., the first module) that sets the gain value (202), captures a data form (204), calculates a correct gain (206), stores the gain in memory (208), compares the delta between the gain value used and the calculated gain to a threshold (210) and if the delta is less than the threshold uses the data form for decoding (212).

In a similar fashion, the '200 Ju patent teaches at Column 6, lines 36-60 an exposure control circuit that sets the exposure value (216), captures a data form (218), calculates correct exposure (220), stores the exposure in memory (222) compares the delta between the exposure value used and the calculated exposure to a threshold (224) and if the delta is less than the threshold uses the data form for decoding (226).

Thus, in the Ju teachings the first module controls the gain and calculates a new gain and the second module controls the exposure and calculates a new exposure. The present invention is distinguishable, in that the first module controls the exposure and gain and the second module calculates a new exposure and gain (i.e., determines a targeted exposure and gain).

In the present invention the functions performed in the first and second modules have significant advantages over the manner in which the '200 Ju patent proposes. By way of example, the images from the imager may contain millions of pixels. This is a large amount of data that must be considered by the processor in order to calculate the exposure and the gain. In

the '200 Ju patent the image data must be processed *twice,* once by the gain control circuit and once by the exposure control circuit. Conversely, Claim 1 of the present invention limits the processing of the image data to the second module, thereby decreasing the data processing demands placed on the processor.

Additionally, the '200 Ju patent has two circuits/modules that must communicate exposure and gain information to the imager. In Claim 1 of the present invention only the first module need be in communication with the imager. Thus, the present invention simplifies the interface to the image.

For these reasons the Applicant believes that Claim 1 is clearly distinguishable from the teachings of the '200 Ju patent. The Applicant also believes that since dependent Claims 1 –17 and 36 provide for further limitation they must be patentable as a matter of law.

According to the Examiner the '200 Ju patent teaches the additional limitation of Claim 3. Specifically, the Examiner states that Ju discloses that the processor provides the imaging device with multi-tasking capabilities. According to the Examiner, at least gain and exposure tasking capabilities are performed concurrently at the power up as shown in Figures 2 and 3; Columns 6, lines 5-61.

The '200 Ju patent Does Not Teach or Suggest a Processor that Controls and Sets Gain and Exposure and Provides the Imaging Device with Multi-Tasking Capabilities.

The Examiner states in the Office Action that an inference can be drawn that the processor has multi-tasking capabilities based upon the recitation in the '200 Ju patent that the gain control circuit and exposure control circuit occur "at power up". (Column 6, lines 16 and 40). The Examiner additionally infers that since both circuits are initiated "at start up" they must occur concurrently and that concurrent processing equates to multi-task processing. The

Applicant disagrees with the Examiners inferences for the following reasons and the Applicant finds no teaching or suggestion in the '200 Ju patent that the exposure and gain control and setting are performed by a processor with multi-tasking capabilities.

Although the '200 Ju patent states that the processes occur "at start up" there is no basis for the assumption that these processes occur concurrently. Those skilled in the art will appreciate that the term "at start up" may mean a short period of time after power up. It is altogether possible that Ju envisioned that gain and exposure processes occurring serially (i.e., either the gain or exposure process being set first, followed by the other process.) If, in fact, the gain and exposure processes occur serially then the teachings of Ju provide no basis for inference that the processor of Ju provide the imaging device with multi-tasking capabilities.

However, *even if the Ju' 200 patent intended for the term "at power up" to imply concurrency*, then Ju does not imply a processor with multi-tasking capabilities because multi-tasking cannot provide concurrency. Those skilled in the art will appreciate that in a processor running a multi-tasking operating system, there are multiple tasks that may compete for processing time. However, a single processor can only execute one task at a time. The operating system will have a scheduler that is responsible for deciding when the processor will run operations in the various tasks. Typically, tasks with higher priority are given preference over tasks with a lower priority. For example, the scheduler may decide to preempt a low priority task and run a higher priority task instead. Additionally, tasks of equal priority that are ready to run at the same time will typically be executed in a round-robin fashion.

The present invention goes to great length to provide a teaching whereby the first module that controls exposure and gain will typically be executed at high priority and the second module will typically executed at low priority. Such prioritization is essential to the invention, in that, the high priority of the first module allows for allows for exposure and gain settings to be determined for every frame that is captured., while the low priority of the the second module will allow for the second module to be preempted based on priority hierarchy.

For these reasons the Applicant believes that Claim 3 is clearly distinguishable from the teachings of the '200 Ju patent.

According to the Examiner the '200 Ju patent teaches the additional limitation of Claim 4. Specifically, the Examiner states that Ju discloses that the processor executes at least one application program. According to the Examiner, the bit map decoder is an application program executed by the processor, as discussed at Column 7, lines 20-29.

The '200 Ju patent Does Not Teach or Suggest an Application Program Executed by the Imager Processor, in that, the Bit Map Decoder is Not an Application Program.

According to the Examiner the '200 Ju patent teaches the processor executing a bit map decoder routine, which the Examiner defines as an application program. The applicant disagrees that the bit map decoder routine constitutes an application program.

As is known by those of ordinary skill in the art, application programs are programs that communicate with a user through a user interface. The user interface is any means by which a user can enter information into or control a device and/or receive information from a device. For example, the user interfaces in the portable data collection system described in the Ju teachings are the display, the keyboard, the trigger switch and the touch panel. By definition, the bit map decoder is not an application program because it does not output data or receive input from the device user. The bit map decoder outputs data that goes to the data transfer link (53), See Column 7, lines 28-29 of the '200 Ju patent.

As further evidence that the '200 Ju patent does not support a processor that executes both a gain and exposure control routine and application programs, the data collection systems

taught by Ju are characterized by a distributed computing environment, in which, multiple processors communicate over a data link and do not share the same memory . In the '200 Ju patent, the first processor (Figure 1, 51) is located on the decoder board (56) and executes the gain control circuit and the exposure control circuit. The second processor (Figure 10, 13) is located on the main control board (31). The '200 Ju patent describes how the decoder board is electrically connected to the main control board via link (53).

The inventive concepts disclosed in the '200 Ju patent do not warrant discussion of the functionality of the second processor. However, state of the art portable data collection terminals at the time of Ju invention implemented main control board processors that were responsible for, but not limited to, control of the trigger switch (16), key switches (22), display screen (32), touch panel (44), serial port (Column 10, line 66-67) and spread spectrum radio (33). Also, as known by those of ordinary skill in the art, applications programs would run on the main control board processor because that processor allows the application to access the user interface devices (i.e., the keyboard, display and the like) as a means of communicating with the user.

In the background section of the current application, Page 3, lines 7-11, the Applicant distinguishes such distributed computing devices, as follows:

> *In most current portable imaging devices that incorporate multiple processors the implementation of automated imager control modules is relatively simplistic because an individual processor can be dedicated to executing the automated exposure control routine while other processors are dedicated to executing operating systems, application programs and the like.*

Thus in the devices taught by the '200 Ju patent, the decoder board processor is dedicated to operating the imager, while the main control board processor executes any, and all, application programs. Claim 4 of the present invention provides for a processor that is dedicated to operating the imager and also executes at least one application program.

For these reasons the Applicant believes that Claim 4 is clearly distinguishable from the teachings of the '200 Ju patent.

According to the Examiner the '200 Ju patent teaches the additional limitation of Claim 5. Specifically, the Examiner states that Ju inherently discloses that the imager processor executes a device operating system.

The '200 Ju patent Does Not Teach or Suggest an Operating System Executed by the Imager Processor.

According to the Examiner the '200 Ju patent inherently teaches the imager processor, executing a device operating system. The applicant disagrees with the assumption that the '200 Ju patent inherently teaches the imager processor executing an operating system.

Referring to the preceding discussion related to Claim 4, the '200 Ju patent teaches a data collection device in which computing is performed in a distributed environment. The processors communicate over a data link and do not share the same memory. The decoder board processor controls the imager, including execution of the gain and exposure circuits and the main control board processor, which is connected to the decoder board processor via a data link, controls all other functions of the device.

Thus, the Ju' patent provides no inherent teaching that the imager processor also executes an operating system of the imaging device. Accordingly, the Applicant believes that Claim 5 is clearly distinguishable from the teachings of the '200 Ju patent.

According to the Examiner the '200 Ju patent all the limitations of Claim 18. Specifically, the Examiner states that the '200 Ju patent teaches feedback from a high priority module to a low priority module (from 210 to 202) in Figures 2 and 3.

The '200 Ju patent Does Not Teach or Suggest a Processor that Implements a High Priority Module for Real Time Control of the Imager and a Lower Priority Module that Examines the Image Signal and Provides Feedback to the High Priority Module Routine.

According to the Examiner high priority and low priority modules are defined within the flow diagrams of Figures 2 and 3. Specifically, the Examiner relies on steps 210 and 202 of Figure 2 to show "feedback" of a gain value and steps 224 and 216 of Figure 3 to show "feedback" of an exposure value. This analysis fails to appreciate the significance of distinct high priority and low priority modules.

In the present invention the high priority and low priority modules are implemented by a multi-tasking operating system. A scheduler within the multi-tasking operating system can direct the processor preempt the lower priority module and give preference to the higher priority module. In this regard, the scheduler will insure that when the processor completes the task or thread within the higher priority module it will continue executing the lower priority module at the point where the lower priority module was preempted. Thus, the scheduler insures that the well-defined order of operations carried out by the lower priority module are persevered, even in the instance in which the lower priority module is preempted.

In the teachings of the '200 Ju patent and, specifically, the Figure 2 gain control flow and the Figure 3 exposure control, there are no operations or steps within the flow that are higher or lower priority than the other operations. Although step 202 is the first operation following power-up, it is not of higher priority than any other operations in Figure 2 because a scheduler cannot preempt other operations in the Figure 2 flow and run step 202 instead. Additionally, the

'200 Ju patent does not teach the gain control circuit (Figure 2) or the exposure control circuit (Figure 3) having higher or lower priority over each other.

Thus, the Ju' patent provides no teaching of a high priority module for real time control of the imager and a lower priority module that examines the image signal and provides feedback to the high priority module. Accordingly, the Applicant believes that Claim 18 is clearly distinguishable from the teachings of the '200 Ju patent.

According to the Examiner the '200 Ju patent all the limitations of Claim 19. Specifically, the Examiner states that the '200 Ju patent teaches:

A method for exposure control in a multi-dimensional imaging device (**Column 5, lines 65-66 and Column 7, lines 13-17**), the method comprising:

generating, at an imager, an end of frame signal (**Column 6, lines 21-22 and 46-47, wherein the end of frame must be generated at the image sensor for the bar code reader to function properly**);

executing, at a central processor (**51**), a first module (**202** and **216**) that controls exposure and gain settings in the imager in response to the end of frame signal (**Figures 2 and 3, wherein the end of frame signal is the signal indicating the EOF of the previous reading session as shown Column 6, lines 16-18 and 40-43**);

generating, in the first module, a captured contrast setting, wherein contrast is defined as the product of the exposure setting and the gain setting (**Figures 2 and 3, in which the gain and exposure setting clearly define contrast setting**);

executing, at the central processor, a second module that calculates a target contrast setting in response to the end of frame signal, the captured contrast setting and stored image data (**Figures 2 and 3**);

generating, in the first module, a subsequent exposure and gain setting for the imager in response to the target contrast setting; and

implementing the subsequent exposure and gain setting in the imager **(gain and exposure feedback loops in Figures 2 and 3, Column 6, lines 16-61 for adjusting gain and exposure in subsequent reading sessions)**.

The '200 Ju Patent Does Not Teach a First Module that Controls the Gain and Exposure and a Second Module that Calculates a Target Contrast in Response to the EOF Signal, the Captured Contrast Setting and the Stored Image Data

The teachings of the '200 Ju patent are distinguishable from the claimed invention in that the Ju patent does not teach a first module that controls the exposure and gain setting in the imager and a second module that calculates a target contrast setting in response to the end of frame signal, the captured contrast setting and stored image data.

The '200 Ju patent teaches at Column 6, lines 14-35 a gain control circuit (i.e., the first module) that sets the gain value (202), captures a data form (204), calculates a correct gain (206), stores the gain in memory (208), compares the delta between the gain value used and the calculated gain to a threshold (210) and if the delta is less than the threshold uses the data form for decoding (212).

In a similar fashion, the '200 Ju patent teaches at Column 6, lines 36-60 an exposure control circuit that sets the exposure value (216), captures a data form (218), calculates correct exposure (220), stores the exposure in memory (222) compares the delta between the exposure value used and the calculated exposure to a threshold (224) and if the delta is less than the threshold uses the data form for decoding (226).

Thus, in the Ju teachings the first module controls the gain and calculates a new gain and the second module controls the exposure and calculates a new exposure. The present invention is distinguishable, in that the first module controls the exposure and gain and the second module calculates a new exposure and gain (i.e., determines a targeted exposure and gain) based upon

the calculation of a target contrast setting in response to the end of frame signal, the captured contrast setting and stored image data.

In the '200 Ju patent the image data must be processed *twice*, once by the gain control circuit and once by the exposure control circuit. Conversely, Claim 1 of the present invention limits the processing of the image data to the second module, thereby decreasing the data processing demands placed on the processor.

Additionally, the '200 Ju patent has two circuits/modules that must communicate exposure and gain information to the imager. In Claim 1 of the present invention only the first module need be in communication with the imager. Thus, the present invention simplifies the interface to the imager.

For these reasons the Applicant believes that Claim 19 is clearly distinguishable from the teachings of the '200 Ju patent. The Applicant also believes that since dependent Claims 20-28 provide for further limitation they must be patentable as a matter of law.

According to the Examiner the '200 Ju patent teaches all the limitations of Claim 29. Specifically, the Examiner rejects Claim 29 using the analysis of Claims 1 and 19.

The '200 Ju Patent Does Not Teach or Suggest Program Instructions that Implements a Method Including a High Priority Routine and a Low Priority Routine.

As previously discussed in relation to Claim 18, the '200 Ju patent provides no teaching of a high priority routine and a low priority routine.

In the present invention the high priority and low priority modules are implemented by a multi-tasking operating system. A scheduler within the multi-tasking operating system can

direct the processor preempt the lower priority module and give preference to the higher priority module. In this regard, the scheduler will insure that when the processor completes the task or thread within the higher priority module it will continue executing the lower priority module at the point where the lower priority module was preempted. Thus, the scheduler insures that the well-defined order of operations carried out by the lower priority module are persevered, even in the instance in which the lower priority module is preempted.

In the teachings of the '200 Ju patent and, specifically, the Figure 2 gain control flow and the Figure 3 exposure control, there are no operations or steps within the flow that are higher or lower priority than the other operations. Although step 202 is the first operation following power-up, it is not of higher priority than any other operations in Figure 2 because a scheduler cannot preempt other operations in the Figure 2 flow and run step 202 instead. Additionally, the '200 Ju patent does not teach the gain control circuit (Figure 2) or the exposure control circuit (Figure 3) having higher or lower priority over each other.

The '200 Ju Patent Does Not Teach a First Module that Controls the Gain and Exposure and a Second Module that Calculates a Target Contrast in Response to the EOF Signal, the Captured Contrast Setting and the Stored Image Data.

As previously discussed in relation to Claim 19, the '200 Ju patent does not teach or suggest a first module that controls the exposure and gain setting in the imager and a second module that calculates a target contrast setting in response to the end of frame signal, the captured contrast setting and stored image data.

The Ju' 200 patent teaches a first module that controls gain and calculates a target gain and a second module that controls the exposure and calculates a target exposure. As previously discussed the present invention executes a first module that controls gain *and* exposure and a second module calculates a target contrast setting in response to the end of frame signal, the captured contrast setting and stored image data.

For these reasons the Applicant believes that Claim 29 is clearly distinguishable from the teachings of the '200 Ju patent. The Applicant also believes that since dependent Claims 30-35 provide for further limitation they must be patentable as a matter of law.

According to the Examiner the '200 Ju patent teaches all the elements of Claim 37. Specifically, the Examiner addresses Claim 37 in relation to the analysis of Claim 1 and 3.

The '200 Ju patent Does Not Teach or Suggest a Multi-Tasking Operating System that Implements a Multi-Tasked Exposure Control Routine.

The '200 Ju patent provides no teaching of a multi-tasking operating system and, more specifically, no teaching or suggestion of a multi-tasking operating system that implements a multi-tasked exposure control routine. The applicant finds no reference in the '200 Ju patent to a multi-tasking operating system. Additionally, no basis for an inherent multi-tasking operating system can be drawn because the '200 Ju patent teaches a distributed computing device and fails to teach a multi-tasked exposure control routine.

As previously noted the data collection devices taught by the '200 Ju patent are characterized by a distributed computing environment. The first processor (Figure 1, 51) is located on the decoder board (56) and executes the gain control circuit and the exposure control circuit. The second processor (Figure 10, 13) is located on the main control board (31). The '200 Ju patent describes how the decoder board is electrically connected to the main control board via link (53). Each of these processors are assigned their own routines and tasks and are not capable of running routines or tasks assigned to the other processor if they are idle.

Additionally, the Examiner states in the Office Action that an inference can be drawn that the processor has multi-tasking capabilities based upon the recitation in the '200 Ju patent that

the gain control circuit and exposure control circuit occur "at power up". (Column 6, lines 16 and 40). The Examiner additionally infers that since both circuits are initiated "at start up" they must occur concurrently and that concurrent processing equates to multi-task processing. The Applicant disagrees with the Examiners inferences for the following reasons and the Applicant finds no teaching or suggestion in the '200 Ju patent that the exposure and gain control and setting are performed in a multi-tasking routine.

Although the '200 Ju patent states that the processes occur "at start up" there is no basis for the assumption that these processes occur concurrently. Those skilled in the art will appreciate that the term "at start up" may mean a short period of time after power up. It is altogether possible that Ju envisioned that gain and exposure processes occurring serially (i.e., either the gain or exposure process being set first, followed by the other process.) If, in fact, the gain and exposure processes occur serially then the teachings of Ju provide no basis for inference that the exposure control routine is a multi-task exposure control routine.

However, *even if the Ju' 200 patent intended for the term "at power up" to imply concurrency*, then Ju does not imply multi-tasking capabilities because multi-tasking cannot provide concurrency. Those skilled in the art will appreciate that in a multi-tasking operating system, there are multiple tasks that may compete for processing time. However, a single processor can only execute one task at a time. The operating system will have a scheduler that is responsible for deciding when the processor will run operations in the various tasks. Typically, tasks with higher priority are given preference over tasks with a lower priority. For example, the scheduler may decide to preempt a low priority task and run a higher priority task instead. Additionally, tasks of equal priority that are ready to run at the same time will typically be executed in a round-robin fashion.

Thus, a processor with multi-tasking capabilities does not allow the processor to execute more that one task at a time. In order to implement gain and exposure in code and have them operate concurrently at power up, at least two microprocessors would have to be employed, one

to run the gain control and a second one to run the exposure control. If two or more microprocessors are implemented it would obviate the need to provide for a single processor capable of multi-tasking.

For these reasons the Applicant believes that Claim 37 is clearly distinguishable from the teachings of the '200 Ju patent. The Applicant also believes that since dependent Claims 38-47 and 36 provide for further limitation they must be patentable as a matter of law.

As such, applicant respectfully submits that all of the independent claims, which have been rejected under 35 U.S.C. § 102 (b), as well as the dependent claims that depend there from, are not anticipated by legal standards and, are thus, patentable.

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35 U.S.C. § 103 (a) Rejections

Claims 14-17 stand rejected under 35 U.S.C. 103 (a) as being unpatentable over the '200 Ju patent in view of United States Patent No. 5,548,108 issued to Moldskred et al. (the '108 Moldskred patent).

The Examiner relies on the '108 Moldskred patent to show a teaching of a DMA controller (Claim 14), a processor including a DMA controller (Claim 15), a programmable logic device (Claim 16) and a programmable logic device including a DMA controller.

Claims 14-17 are dependent claims that depend form independent Claim 1. The applicant believes that Claim 1 has clearly been distinguished from the teachings of the primary '200 Ju patent reference. As a matter of law, the dependent claims, which add further limitations to the independent claim, must be found to be patentable if the independent claim is patentable.

Conclusion

In view of the proposed amended claims and the remarks submitted above, it is respectfully submitted that the present claims are in condition for immediate allowance. It is therefore respectfully requested that a Notice of Allowance be issued. The Examiner is encouraged to contact Applicant's undersigned attorney to resolve any remaining issues in order to expedite examination of the present invention.

It is not believed that extensions of time or fees for net addition of claims are required, beyond those that may otherwise be provided for in documents accompanying this paper. However, in the event that additional extensions of time are necessary to allow consideration of this paper, such extensions are hereby petitioned under 37 CFR § 1.136(a), and any fee required therefore (including fees for net addition of claims) is hereby authorized to be charged to Deposit Account No. 16-0605.

Respectfully submitted,

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